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ZOÖLOGICAL BULLETIN.

NOTES ON THE OCCIPITAL REGION OF THE TROUT, *TRUTTA FARIO*.

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ABOUT a year and a half ago I undertook an investigation for the purpose of determining the number of segments in the hinder part of the head in the Teleostei. Only when the work was nearly complete did it come to my attention that Harrison, in his paper entitled "Die Entwicklung der unpaaren und paarigen Flossen der Teleostier," had covered much of my ground. Under these circumstances it seemed unwise to continue the investigation. But as my results embody a few new points, I give herewith a brief summary of them.

The material was obtained from the Zürich fish breeding station and consisted of eggs of the salmon, *Salmo salar*, and the trout, *Trutta fario*. When they came into my hands, the salmon eggs had already been developing twenty-nine days in water of 10° Centigrade, and required twenty-eight days in water of about 7°–8°¹ to hatch. The age of the trout eggs was unknown, but I estimated them to be about four days older; they required twenty-two days in water of about 7°–8° to hatch. The material was preserved in an aqueous solution of corrosive sublimate, to which was added 20% of glacial acetic acid; it was then imbedded in paraffin, sectioned, and stained with haemalum. The greater part of the work was done upon the trout, the salmon being used only for comparison.

¹The temperature was not determined at the time, so that this is merely an approximate estimate based upon the observations of others.

I take as the basis of my description the youngest of the trout embryos. The following data will indicate their approximate age: The length was a little less than 1 cm.; the spinal ganglia were formed, but the anterior ones were still connected by a longitudinal commissure with the vagus; the operculum had covered the first branchial arch. The characteristic structures of a segment at this stage are: (*a*) a pair of myotomes; (*b*) a spinal nerve with a ventral root and a dorsal ganglion which is not as yet directly connected with the spinal cord by a dorsal root; (*c*) a portion of condensed mesoblast forming the anlage of the axial skeleton. These structures I will take up successively in order to compare the condition in the most anterior segments with that which obtains farther back.

The myotomes are well differentiated and in general similar; they extend forward to the foramen for the vagus, the first one lying close behind the condensed mesoderm which invests the ear. Striation of the fibers is already present but is not uniform, being generally more pronounced in the deeper parts. The time at which striation appears seems to be variable; in a second specimen nine days older than this it is barely indicated.

The anterior three myotomes lie laterad of the parachordals and accordingly represent post-otic cephalic segments; they resemble the posterior ones but lie more laterad, as if pushed out by the enlargement which forms the hind brain. In front of the lateral portion of the most anterior one on the right side is a small triangular mass of tissue in which a few unstriated longitudinally disposed muscular fibers are to be seen, and which undoubtedly represents another nearly atrophied myotome, *making the number of post-otic cephalic segments four*. I propose at the earliest opportunity to examine younger embryos in the hope of finding this first myotome better developed. In salmon embryos I have found no trace of it, though I have not made a search exhaustive enough to warrant me in asserting that it is absent. In trout embryos one day older than the one just described, it has disappeared; the succeeding (second) myotome pair also eventually atrophies, though I am unable to say just when. Seven days after hatching it shows no trace of degeneration; in trout of fourteen days it has entirely dis-

appeared. It undoubtedly corresponds to the temporary myotome pair found by Harrison in *Salmo*.

The anlage of the axial skeleton consists at this time of condensed mesoderm aggregated on either side of the chorda, especially along the dorso-lateral and ventro-lateral lines, extending up the neural canal nearly to the top of the spinal ganglia and broadening anteriorly into the parachordals. This anterior broadening begins opposite the fifth myotome. The mesoderm shows no trace of segmentation, except that it is marked at intervals by ridge-like vertical thickenings corresponding to the myosepta. Such ridges are present also on the parachordals opposite the myosepta between segments 2 and 3, 3 and 4, 4 and 5. Cartilage is present in an embryo nine days older; it has the form of paired rods (neural arches) flanking the spinal cord. Each rod lies with its ventral end in a myoseptum, but crosses the myotome obliquely, so that its dorsal end lies in or near the next anterior myoseptum. The foremost rods cross the fifth myotome pair; they are considerably smaller than the others, and are closely connected by condensed mesoderm with the parachordals. They are obviously the anlage of the neural arch (occipitalbogen), which in the Salmonidae fuses with the skull. In specimens of twenty-one days after hatching, no fusion has yet taken place. The parachordals in my youngest embryos are largely chondrified; the cartilage exists as a continuous mass which shows no suggestion of segmentation. According to Stöhr, that portion which lies behind the otic capsules ("hintere Parachordalplatten") chondrifies on either side from a single center.

We come now to the nerves. The two temporary segments are altogether without them, but the first permanent segment has a rudimentary one; the second permanent segment has a typical spinal nerve which differs in no respect from the succeeding ones, and in my oldest embryos (twenty-one days after hatching) shows no sign of degeneration. Harrison states that in salmon somewhat older the dorsal root is atrophied. The rudimentary nerve of the first permanent segment is present in my youngest embryos. It is better developed on the right side, and here has the typical structure of a spinal nerve, differing

from the succeeding ones only in being much smaller. On the left the ventral root is wanting. On each side the dorsal ganglion is connected by a longitudinal commissure anteriorly with the ganglion of the vagus, posteriorly with the spinal ganglion of the next nerve. This rudimentary nerve has disappeared entirely, or, at most, has left only a trace in embryos nine days older; in those which have been hatched fourteen days, the nerve of the second permanent segment innervates also the first segment. This nerve and the one belonging to the next succeeding segment leave the neural canal by the

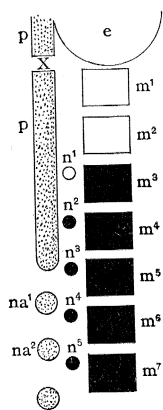


Diagram representing the changes which take place in the cephalic region of the trout between the fifth and tenth weeks of development. e, auditory organ; m^1 – m^7 , myotomes; n^1 – n^5 , spinal nerves; na^1 – na^2 , neural arches; p, parachordal; X, position of vagus. Shaded or dotted structures are permanent; those which are left light disappear in the course of development.

same foramen, namely, the one between the first neural arch and the parachordal. They correspond with those considered by Harrison to be the hypoglossal and the first dorsal. I have not traced their distribution, and am therefore unable to express an opinion on this point.

SUMMARY.

The cephalic region of the trout consists then of at least four segments. These are represented by more or less perfectly developed myotomes of which the first two pairs atrophy in the course of development. The skeletal anlage shows no trace of segmentation. The third segment has a rudimentary spinal nerve which early atrophies; the fourth has a typical one which three weeks after hatching shows no sign of degeneration. The condition cannot be better represented than by a diagram similar to that already employed by Sewertzoff.

This investigation was carried on in the laboratory of the University of Zürich, and I gladly take this opportunity of thanking Professor Lang for his kindly aid and interest, as well as for the generous way in which material was placed at my disposal.